

Reduction Through Renovation

Presented to

Kentucky High Performance Schools Conference

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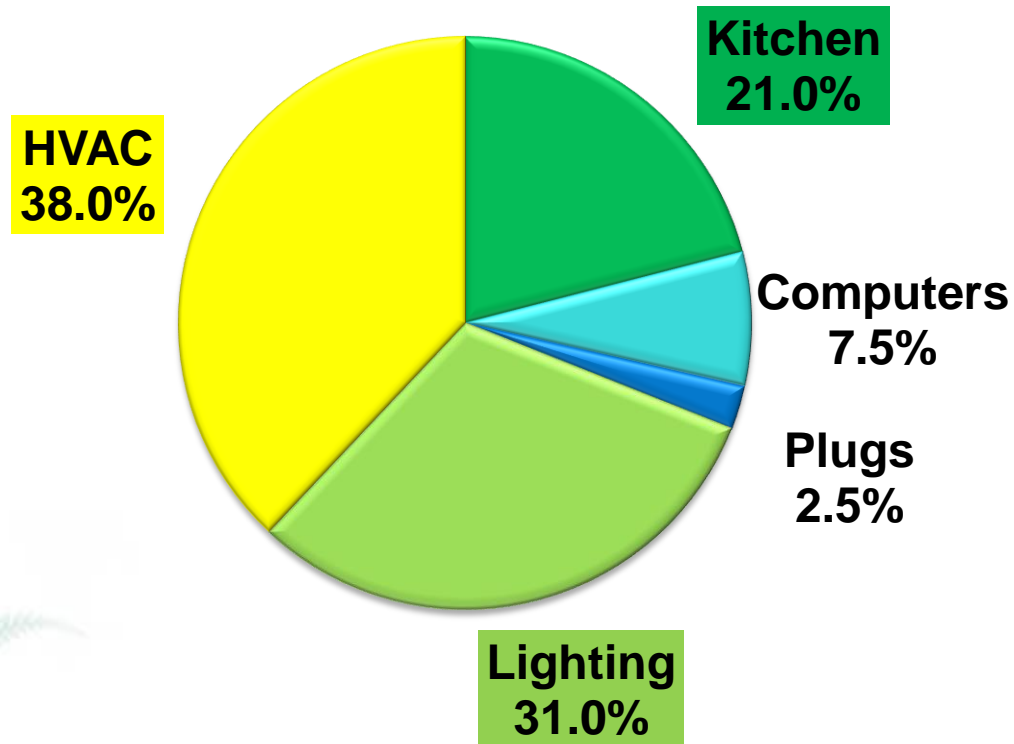


About CMTA

- Top 60 MEP engineering firm
- 29 PEs
- 62 ENERGY STAR projects
- 56 ENERGY STAR schools
- 6 ENERGY STAR projects with perfect scores of 100
- Three Net Zero Energy Schools in operation
- Eight Net Zero Energy projects in design or construction



Reduction Through Renovation



Reduction Through Renovation HVAC Systems

Considerations

- Budget
- Construction Schedule
- System Maintenance

Challenges

- Structure
- Site Availability
- Acoustics



HVAC- Why geothermal for renovations?



HVAC – Why Geothermal? MONEY!

🌿 Improved lifecycle cost

- Annual energy cost
- Maintenance cost
- Replacement cost
- Staff and training costs

🌿 Increased flexibility and reliability

🌿 Payback



HVAC – Why Geothermal?

SIMPLICITY!

- 🌿 Eliminates central plant equipment
- 🌿 No heating/cooling changeover
- 🌿 Easier to commission
- 🌿 Quicker start-up/smooth shutdown
- 🌿 Easier to maintain
- 🌿 Flexible renovations



HVAC – Why Geothermal? ENERGY!

- 🌿 Highly efficient
- 🌿 Fan energy reduced
- 🌿 Reheat eliminated
- 🌿 Energy recovery easier
- 🌿 Pumping energy reduced
- 🌿 Occupied/Unoccupied strategies easier



Kitchen HVAC Systems

Use Type II Hoods in lieu of Type I

- 🌿 **Type I (wall mounted)**
 - Grease Laden Vapors
 - Fire Suppression
 - 400 CFM/ft
- 🌿 **Type 2 (wall mounted)**
 - 200 CFM/ft
- 🌿 **Additional savings for an island canopy**



Kitchen HVAC Systems



Dedicated Make-up Air

- Cane Run – Direct Gas Fired
- East Middle – Direct Gas Fired
- Foster Heights – Heat Pump w/electric preheat

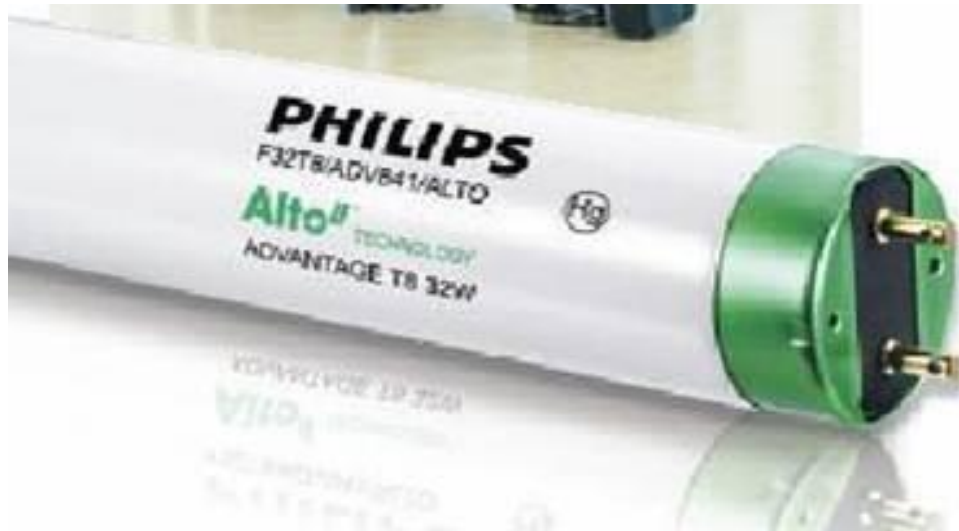


Kitchen HVAC Systems

**Size appropriately for
kitchen equipment**



Lighting – Watts per Square Foot



🌿 **IECC 2006 – 1.2 w/ sq. ft.**

🌿 **Design**

- 30% better than code
- Foster Heights Elementary – 0.86 w/ sq. ft.
- East Middle School – 0.84 w/ sq. ft.
- Cane Run Elementary – 0.87 w/ sq. ft.



Interior Artificial Lighting Strategies

- 🌿 **“Right Size” Lighting**
- 🌿 **Occupancy Sensors**
- 🌿 **High Performance T8 Lamps**
- 🌿 **Ballast Tuning**
- 🌿 **Efficient Light Fixtures**
- 🌿 **Lighting Control**
- 🌿 **Tubular Daylight Devices**



Case Studies

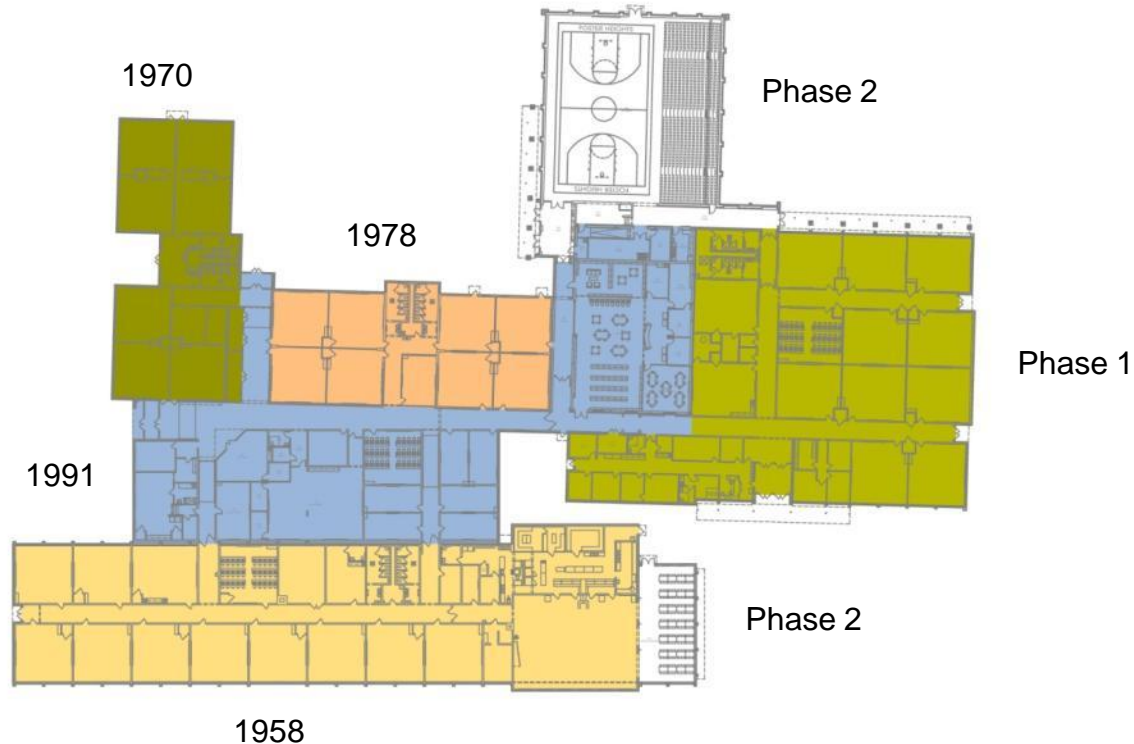
Conventional vs. Efficient



Foster Heights Elementary

- 🌿 Nelson County, Kentucky
- 🌿 56,638 square foot renovation
- 🌿 20,044 square foot expansion

- 🌿 \$6.3 Million
- 🌿 Phase I Construction Completed 2010
- 🌿 Phase II Construction Completed 2011



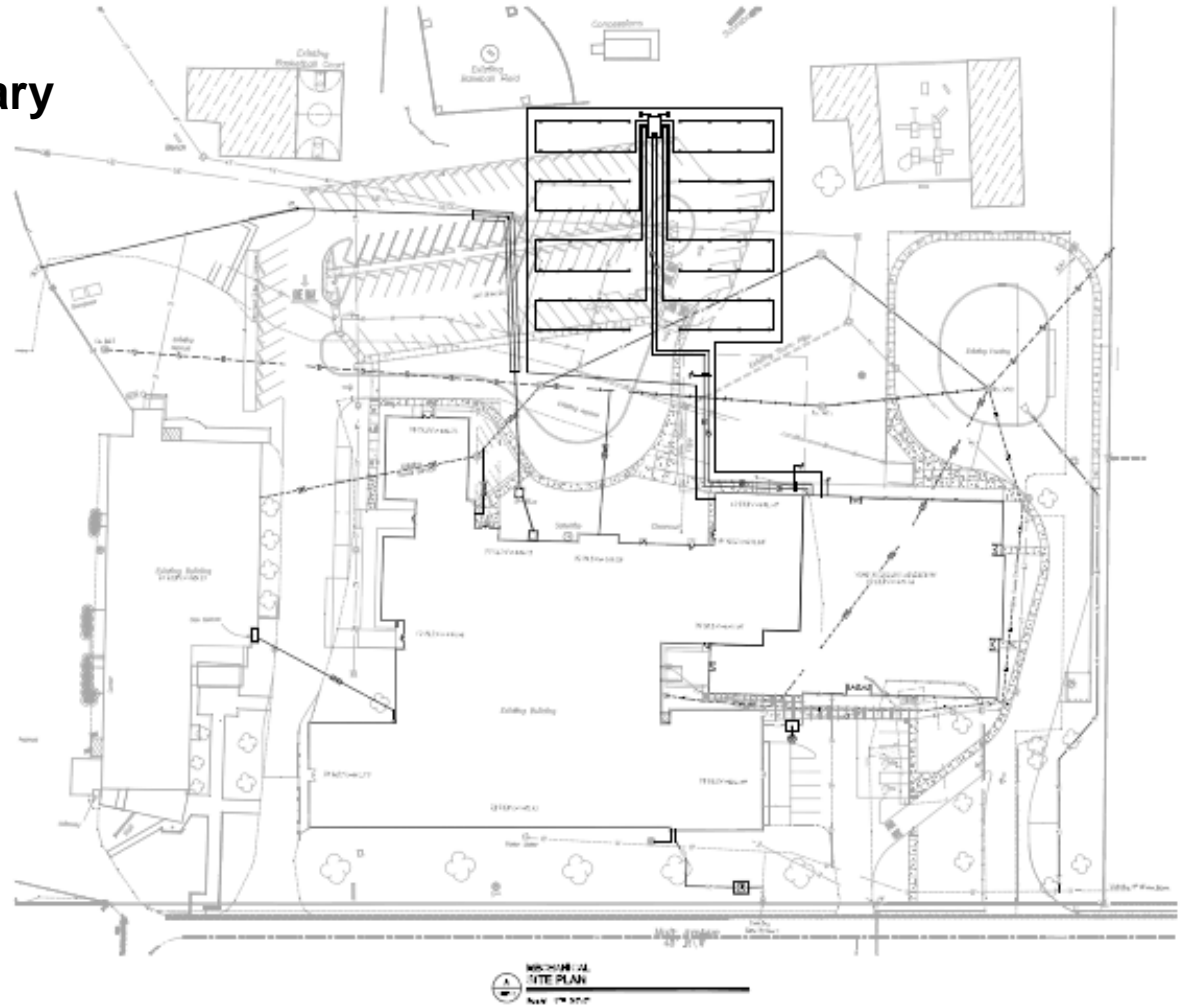
Foster Heights Elementary

Existing HVAC	Renovation	Sustainable Design
<ul style="list-style-type: none"> -2-pipe Unit Ventilation -Air Cooled Chiller -Gas Fin Tube Boiler -Did not meet Current Ventilation Requirements 	<ul style="list-style-type: none"> -2-pipe Unit Ventilation -Air Cooled Chiller -Condensing Boiler -Current Code Compliant Ventilation 	<ul style="list-style-type: none"> -Geothermal Heat Pumps -Air Cooled ERV Rooftop Dedicated Outside Air Unit -Distributed Pumping -Current Code Compliant Ventilation
48 kBtu/sf yr	61-62 kBtu/sf yr	29 kBtu/sf yr
HVAC Construction Costs	\$20/ square foot	\$23/ square foot



Challenges – Site

Foster Heights Elementary



Challenges – Structure

Structural Support for Rooftop Equipment



Existing Roof Air Cooled Chiller



Challenges – Structure

- 🌿 Reduction in roof mounted equipment and penetrations from 57 to 14
- 🌿 75% reduction



Challenges – Structure

- 🌿 Mechanical closet locations
- 🌿 Ceiling heights and structural coordination



Foster Heights Elementary



Existing HVAC	Renovation	Sustainable Design
-2-pipe Unit Ventilation -Air Cooled Chiller -Gas Fin Tube Boiler -Did not meet Current Ventilation Requirements	-2-pipe Unit Ventilation -Air Cooled Chiller -Condensing Boiler -Current Code Compliant Ventilation	-Geothermal Heat Pumps -Air Cooled ERV Rooftop Dedicated Outside Air Unit -Distributed Pumping -Current Code Compliant Ventilation
48 kBtu/sf yr	61-62 kBtu/sf yr	29 kBtu/sf yr
HVAC Construction Costs	\$20/ square foot	\$23/ square foot

PREMIUM: \$230,000

ENERGY STAR
Score – 98
2010



East Middle School

- 🌿 **Shelby County,
Kentucky**
- 🌿 **68,000 square foot
renovation**
- 🌿 **\$3.7 Million**
- 🌿 **Construction
Completed 2009**

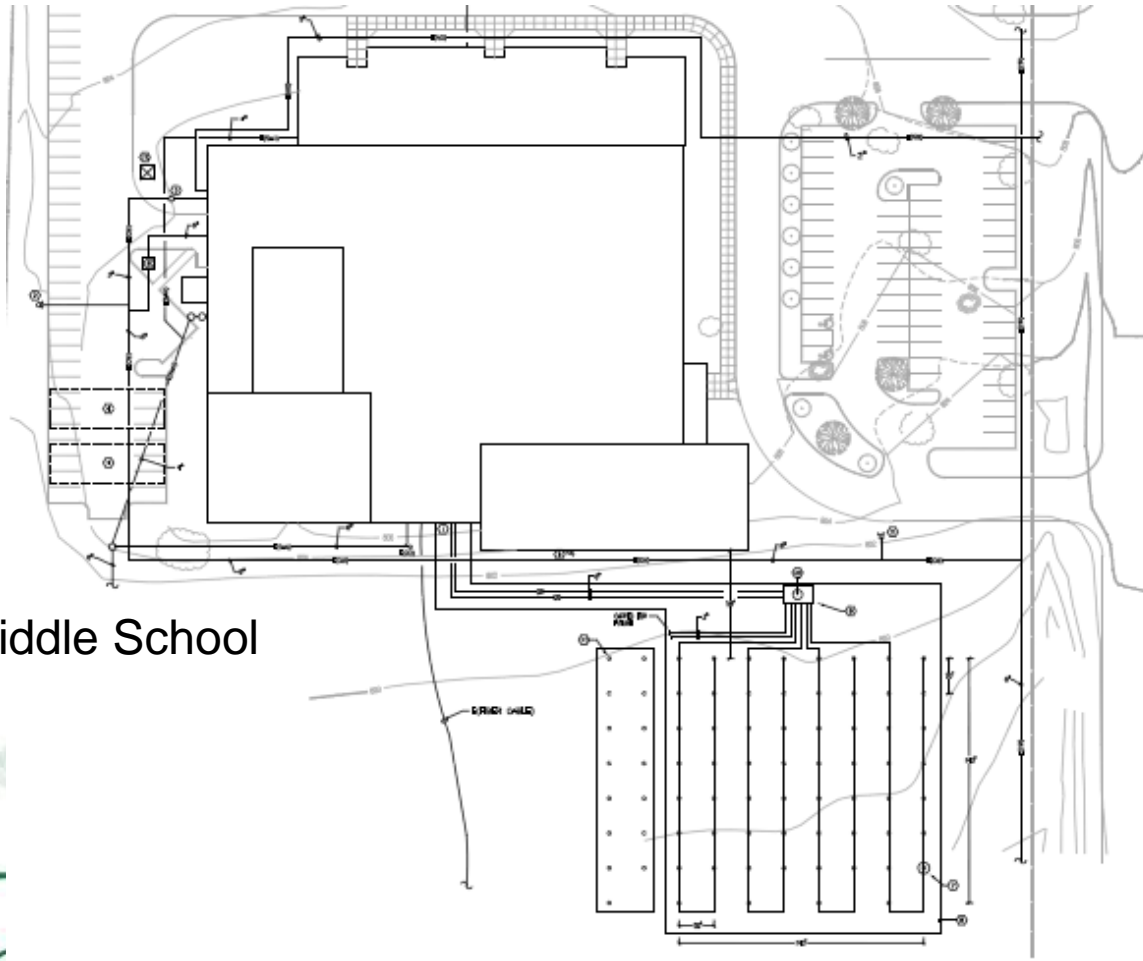


East Middle School

Existing HVAC	Renovation	Sustainable Design
<ul style="list-style-type: none"> -2-pipe Unit Ventilation -Air Cooled Chiller -Gas Fin Tube Boiler -Did not meet Current Ventilation -No A/C in Gym or Kitchen 	<ul style="list-style-type: none"> -2-pipe Unit Ventilation -Air Cooled Chiller -Condensing Boiler -Current Code Compliant Ventilation -A/C in Gym and Kitchen 	<ul style="list-style-type: none"> -Geothermal Heat Pumps -Air Cooled ERV Rooftop Dedicated Outside Air Unit -Distributed Pumping -Current Code Compliant Ventilation -A/C in Gym and Kitchen
52 kBtu/sf yr	62 kBtu/sf yr	33 kBtu/sf yr
HVAC Construction Costs:	\$20/ square foot	\$25/ square foot

Challenges – Site

East Middle School

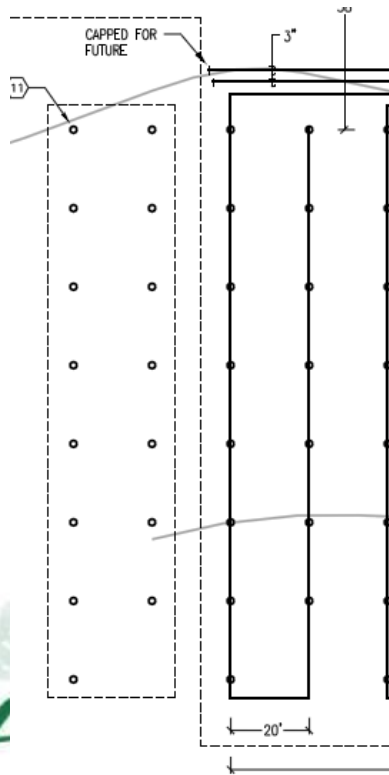


SITE PLAN - MECHANICAL
SCALE 1"=30'-0"



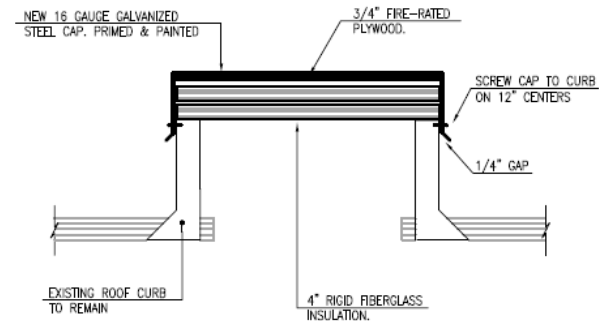
Challenges – Site

- 🌿 Dedicated area for future wells
- 🌿 Size and Cap Piping



Challenges – Future/Budget

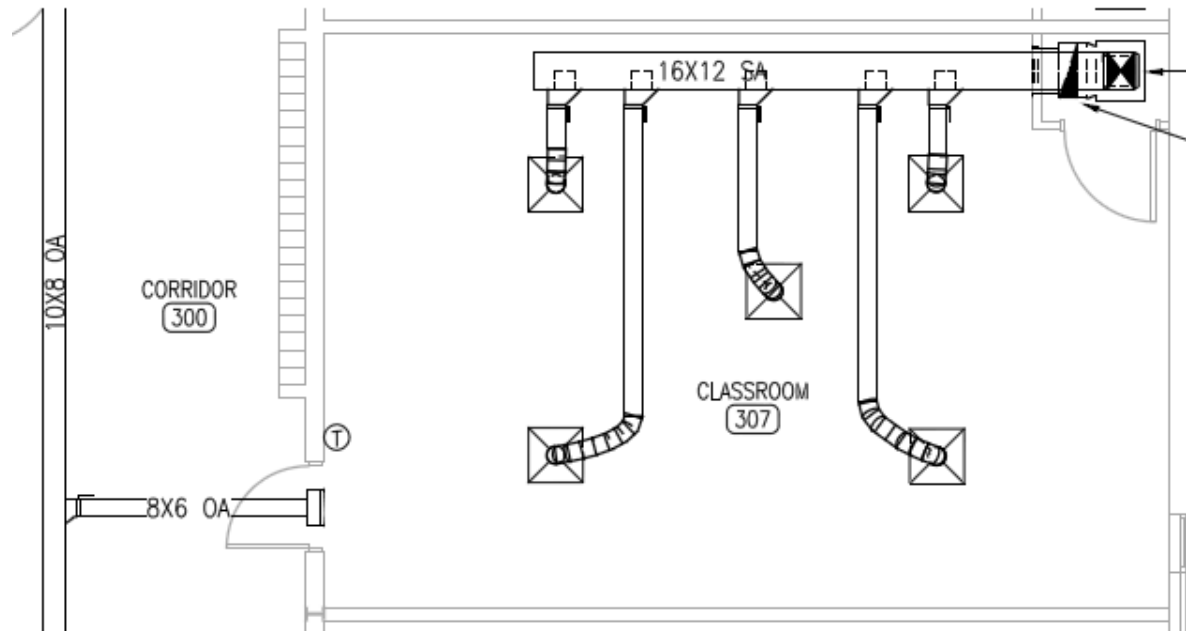
🌿 Cap roof penetrations



ROOF CURB CAP DETAIL

NOT TO SCALE

Challenges – Structure



Locations for heat pumps close to the area served

East Middle School



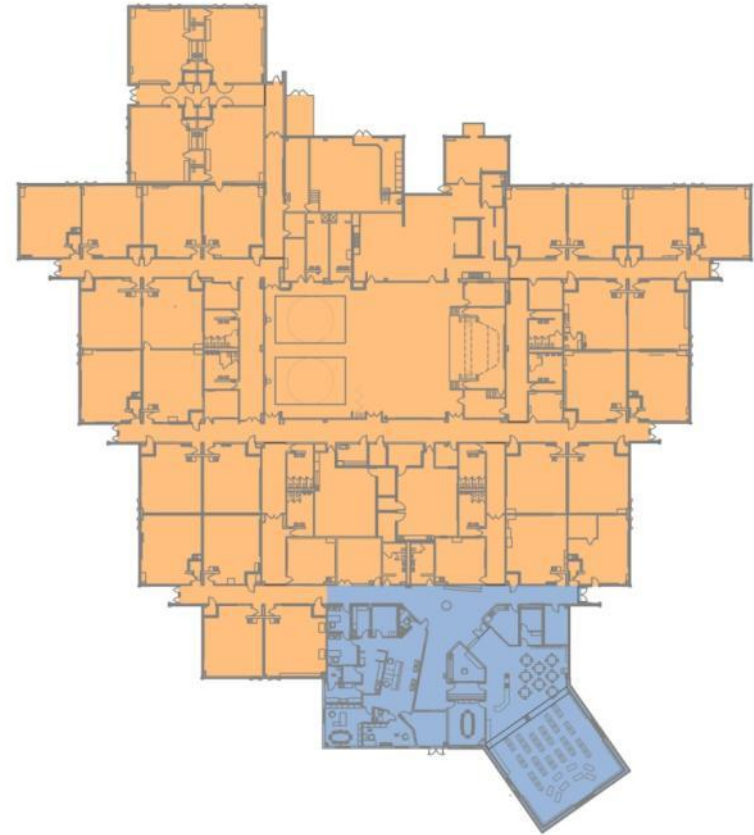
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<ul style="list-style-type: none"> -2-pipe Unit Ventilation -Air Cooled Chiller -Gas Fin Tube Boiler -Did not meet Current Ventilation -No A/C in Gym or Kitchen 	<ul style="list-style-type: none"> -2-pipe Unit Ventilation -Air Cooled Chiller -Condensing Boiler -Current Code Compliant Ventilation 	<ul style="list-style-type: none"> -Geothermal Heat Pumps -Air Cooled ERV Rooftop Dedicated Outside Air Unit -Distributed Pumping -Current Code Compliant Ventilation
52 kBtu/sf yr	62 kBtu/sf yr	33 kBtu/sf yr
HVAC Construction Costs:	\$20/ square foot	\$25/ square foot

PREMIUM: \$340,000



Cane Run Elementary

- 🌿 **Jefferson County, Kentucky**
- 🌿 **57,700 square foot renovation**
- 🌿 **3,020 square foot expansion**
- 🌿 **\$5.3 Million**
- 🌿 **Construction Completed 2010**



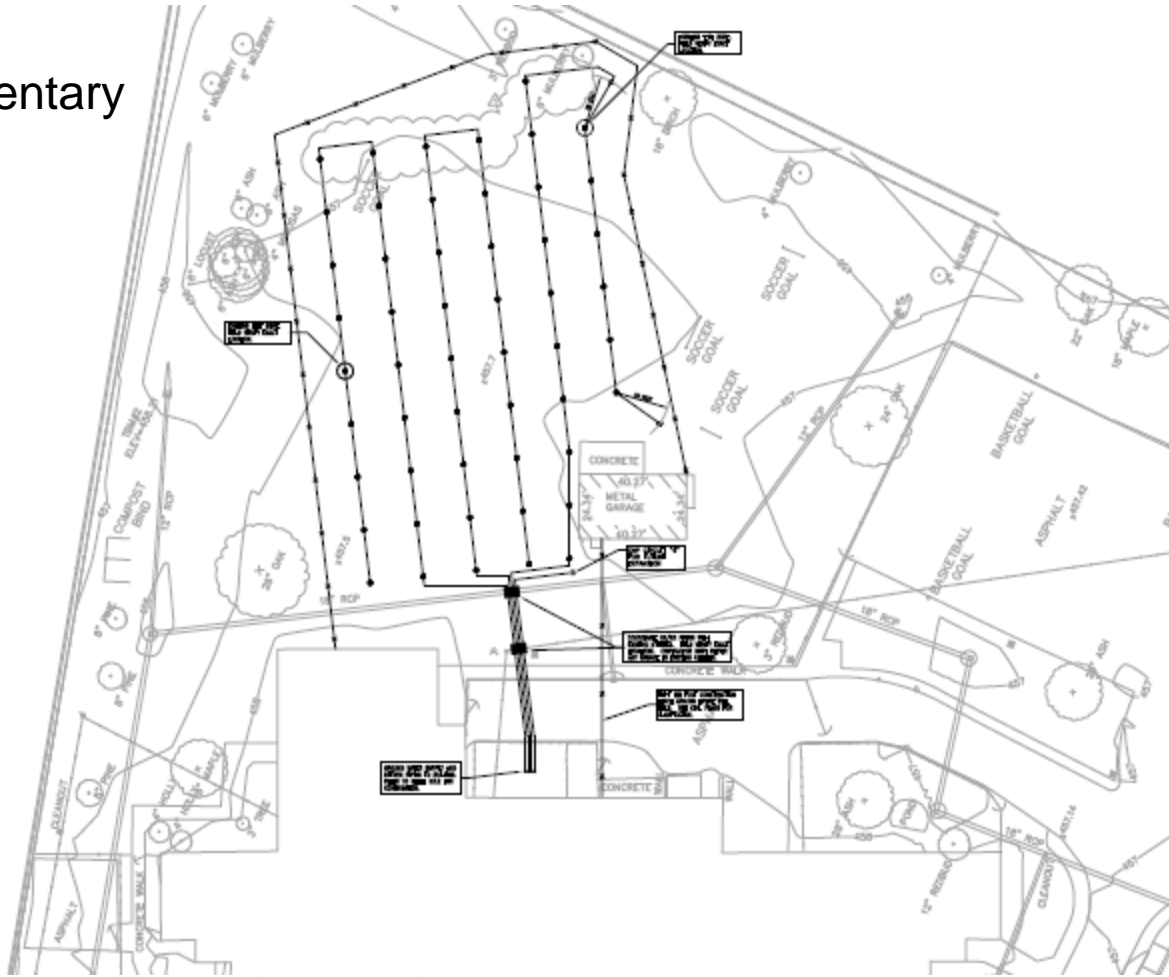
Cane Run Elementary

Existing HVAC	Renovation	Sustainable Design
<ul style="list-style-type: none">-Constant Volume with Hot Water Reheat-Air Cooled Chiller-Gas Cast Iron Boiler	<ul style="list-style-type: none">-Variable Volume with Hot Water Reheat-Air Cooled Chiller-Condensing Boiler	<ul style="list-style-type: none">-Geothermal Heat Pumps-Heat Pump Chiller-Outside Air Unit-Distributed Pumping
92 kBtu/sf yr	60 kBtu/sf yr	38 kBtu/sf yr
HVAC Construction Costs	\$22/ square foot	\$28/ square foot



Challenges – Site

Cane Run Elementary



Cane Run Elementary



Existing HVAC	Renovation	Sustainable Design
<ul style="list-style-type: none">-Constant Volume with Hot Water Reheat-Air Cooled Chiller-Gas Cast Iron Boiler	<ul style="list-style-type: none">-Variable Volume with Hot Water Reheat-Air Cooled Chiller-Condensing Boiler	<ul style="list-style-type: none">-Geothermal Heat Pumps-Heat Pump Chiller-Outside Air Unit-Distributed Pumping
92 kBtu/sf yr	60 kBtu/sf yr	38 kBtu/sf yr
HVAC Construction Costs	\$22/ square foot	\$28/ square foot

PREMIUM: \$364,000

ENERGY STAR
Score – 92
2010



Bottom Line



Bottom Line – Foster Heights

HVAC Cost Premium	\$230,000
Building Square Footage	76,682
Energy Costs prior to Renovation	\$78,300
Energy Costs for Sustainable Renovation	\$67,202
ENERGY STAR - 2010	98
Energy Savings/YR	\$11,098
Simple Payback Period	20.7
<i>Life Cycle Savings (25 years)</i>	\$47,454

Note: Energy costs prior to renovation are adjusted to current energy rates.



Bottom Line – East Middle

HVAC Cost Premium	\$340,000
Building Square Footage	68,000
Energy Costs prior to Renovation	\$89,350
Energy Costs for Sustainable Renovation	\$57,700
ENERGY STAR - 2011	98
kBtu/sf yr – 2011	28.6
Energy Savings/YR	\$31,650
Simple Payback Period	10.7
<i>Life Cycle Savings (25 years)</i>	\$452,595

Note: Energy costs prior to renovation are adjusted to current energy rates.



Bottom Line – Cane Run

HVAC Cost Premium	\$364,000
Building Square Footage	60,720
Energy Costs prior to Renovation	\$123,400
Energy Costs for Sustainable Renovation	\$54,500
ENERGY STAR - 2011	94
kBtu/sf yr – 2011	35
Energy Savings/YR	\$68,900
Simple Payback Period	5.3 years
<i>Life Cycle Savings (25 years)</i>	\$1,358,000

Note: Energy costs prior to renovation are adjusted to current energy rates.



Questions?

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